# System for the joint operation of digitally operating radio appliances that can be adjusted to various waveforms

The invention relates to, and proceeds from, a system according to the preamble of the main claim.

Modern digital technology makes it possible to provide in future digital radio transmitting and/or receiving appliances that have an essentially identical hardware construction and can be operated with different waveforms by reading in different software. In this context, waveform is understood as meaning the signal that appears at the output of the antenna at the transition from the appliance to the radio link and that is determined by a multiplicity of parameters, such as frequency, type of modulation, power, signal shape (e.g. frequency-hopping method). Such a waveform may be determined, depending on complexity, by, for example 20 to 200 individual parameters that are mutually dependent and that are combined to form a set of parameters and are read into the transmitting appliance and/or receiving appliance as software so that the appliance can then be operated with this selected waveform. This modern multifunctional radio appliance principle is described in greater detail, for example, in the paper entitled "Multifunctional Radio Platform for Dual-Use Applications" by Peter Iselt, AFCEA Conference, Munich, 20/21 April 1999.

Such multifunctional radio appliances have hitherto been operated by the various operators with different waveforms and are not interoperable. It would indeed be possible to store all the conceivable or relevant waveforms in such multifunctional radio appliances as complete sets of parameters that can be retrieved by a switch-over command so that such radio appliances can be operated with a common waveform. However, this cannot be achieved in practice because of the enormous memory capacity required for it and the consequently unacceptable loading of the radio appliances platform.

The object of the invention is to disclose a system with which such multifunctional radio appliances can be quickly adjusted via a centre to a predetermined common waveform so that such multifunctional radio appliances initially operated in different systems can communicate with one another in the shortest time.

Proceeding from a system according to the preamble of the main claim, this object is achieved by its characterizing features. An advantageous development emerges from the subclaim.

In accordance with the invention, multifunctional radio appliances that originally operate in various communication systems with different waveforms can be rapidly converted via a centre to a common waveform and thus communicate with one another. For this purpose, it is not the entire set of parameters of the desired common waveform that is transmitted to the individual radio appliances from the centre, but only individual addresses that are assigned to appropriate sets of subparameters that, when combined then yield the entire set of parameters for the desired waveform. This transmission of only individual addresses can take place very rapidly in the shortest time with high transmission reliability. Whereas several hours may be necessary to transmit an entire set of parameters, individual addresses can be transmitted in a few seconds or minutes.

In accordance with a further development of the invention, it has proved expedient to divide the entire software determining a waveform into two subpackets and to store that part of the software that describes the functions and dependencies of the parameters of a set of parameters in the individual radio appliances so that only that determinant part of the software that comprises the sets of parameters has to be retrieved by radio via the individual

addresses in order to operate the radio appliances with a selected waveform. Although the descriptive part of the waveform software could likewise be read out under these circumstances by radio via the appropriate addresses in a waveform-specific combination, it has proved expedient to store said descriptive part of the software in the radio appliance as a permanent software component and to read out only the waveform-specific sets of subparameters via the addresses by radio.

The system according to the invention is suitable both for the civil and for the military communication sector. Thus, for example, actions can be carried out with participants from different alliances that are each working with different technology standards. The cooperation of civil, state or military organizations in the field of catastrophe prevention or in the case of peacekeeping measures is also substantially improved by the system according to the invention.

The invention is explained in greater detail in the following on the basis of an exemplary embodiment with reference to a diagrammatic drawing.

Figure 1 shows the application of the system according to the invention in a crisis zone in which three different radio systems are being operated, for example a German radio system G that operates with a waveform WFG, a French system F that operates with a waveform WFF and a US radio system US that operates according to the waveform WFUS. All of these three initially different radio systems, each comprising radio transmitters and radio receivers, are roughly the same or even identical in regard to their architecture (structure), but they can be adjusted to different waveforms by inputting appropriate software via sets of parameters. In addition, a common radio connection, having, for example, a waveform WFB that is available at

least at certain times and makes possible information exchange between the three initially separate radio systems exists between these three different radio systems G, F and US.

If the three radio systems are now to make contact with one another, for example for tactical reasons, and this is desired, for example, by the German radio system G as managing unit, the command that said radio systems F and US should also be converted to the waveform WFG is transmitted via the common radio connection WFB from the unit G acting as centre to the two other radio systems F and US.

For this purpose, the software for the waveform WFG is transmitted to the participants in the radio systems F and US via the common radio connection WFB.

Since the transmission of the entire software determining the waveform WFG would take several hours, the software determining the waveform WFG is divided, in accordance with Figure 2, into two subpackets, namely a descriptive part and a determinant part. The descriptive part comprises the functions and dependencies of the respective parameters of the waveform, whereas the determinant part comprises the actual parameters and their values. The descriptive part is stored completely in the radio appliance and is part of the operating software for the radio appliance. The sets of parameters of the determinant part for the various possible waveforms are each divided, in accordance with Figure 3, into sets of subparameters to which appropriate addresses are assigned. A set of parameters for a specific waveform, for example WFG, may comprise, for example, one hundred individual parameters or more. All these sets of parameters for the various waveforms are divided into sets of subparameters TPa, TPb, TPc ...TPx and, specifically, such individual parameters are combined in each case to form sets of subparameters so that said sets of parameters can

each be used for a plurality of entire sets of parameters of different waveforms. Each of said sets of subparameters TPa to TPx is assigned in each case an address a, b to x. Said sets of subparameters with the addresses assigned to them are stored in all the radio appliances of the various radio systems G, F and US and, specifically, together with the associated descriptive part of the software in each case.

If a reprogramming of the radio appliances of all three radio systems G, F and US to the waveform WFG is now required via the radio system G acting as centre in the context of the above example, there are transmitted via the radio connection WFB, in accordance with Figure 4 only the addresses whose associated sets of subparameters yield, when combined, the set of parameters that, together with the descriptive part of the software, corresponds to the waveform WFG. Said sets of subparameters are read out of the associated memories of the appliances of the systems F and US and the appropriate appliances are thus adjusted to the common waveform WFG in the shortest time so that the three radio systems G, F and US can communicate with one another via WFG.

The transmission of only addresses via the connection WFB can take place very reliably and error-free, optionally also in encrypted form, so that faulty operations are avoided.